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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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Menachem Nathan

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Discovery Dispatch

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EXAMINER

DOLAN, JENNIFER M

ART UNIT

PAPER NUMBER

2813

DATE MAILED: 01/21/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/632,955

Applicant(s)

NATHAN ET AL.

Examiner

Jennifer M. Dolan

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-35 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-6, 8, 10-15 and 17-35 is/are rejected.
- 7) ☒ Claim(s) 7, 9, 16 and 18 is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 04 August 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. ____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|--|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. ____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>9/15/03</u> . | 6) <input type="checkbox"/> Other: ____ |

DETAILED ACTION

Claim Objections

1. The numbering of claims is not in accordance with 37 CFR 1.126 which requires the original numbering of the claims to be preserved throughout the prosecution. When claims are canceled, the remaining claims must not be renumbered. When new claims are presented, they must be numbered consecutively beginning with the number next following the highest numbered claims previously presented (whether entered or not).

Misnumbered claims 8 (second occurrence thereof) – 34 have been renumbered as claims 9-35, respectively. It is respectfully pointed out that the claim dependencies for newly renumbered claims 12-35 (corresponding to originally numbered claims 11-34) are no longer accurate and must be corrected by the Applicant in a response to this office action. For the purposes of examination, the examiner will assume that each dependency corresponds to the claim intended by the applicant -i.e., newly numbered claim 12 (original claim 11) is considered to be dependent on new claim 11 (original claim 10).

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

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3. Claims 1-6, 8, 10, 11, 13-15, 17, and 19-35 are rejected under 35 U.S.C. 102(e) as being anticipated by U.S. Patent Publication No. 2002/0146196 to Shirane et al.

Regarding claims 1-3, 10, 11, 19, 20, 23, 25-27, and 32-34, Shirane discloses a dynamically controllable photonic crystal (figures 3a, 3b), comprising: a structure having a periodic variation in dielectric constant (paragraphs 0013, 0048, 0075), the structure including a substrate (figures 3a, 3b) having a substrate refractive index (paragraphs 0047, 0048, 00500063, 0075), the structure further including at least one local defect (line-defect waveguide formed by “missing rods”; see paragraph 0048; figures 3b, 6, 7, 12), the line-defect waveguide acting as a micro-cavity (paragraphs 0057, 0058); the structure further including a generic semiconductor (paragraphs 0048-0050) or Si substrate (paragraph 0075) and air rods (paragraph 0048); and electrical means to induce a local change in the substrate refractive index/local carrier refraction (such changes also inherently alter the frequencies supported by the waveguide microcavity) in the vicinity of the local defect (current injection through 36, 37 in figure 3a, for example, changes the carrier concentration, index of refraction, and resonant frequency of the waveguide), thereby affecting dynamically the propagation of an electromagnetic wave through the structure (paragraphs 0009, 0029, 0030, 0047, 0059).

Regarding claims 4, 5, 13, 14, 21, 22, 28, 29, and 35, Shirane discloses means to inject or deplete charge carriers from the semiconductor substrate (paragraph 0063).

Regarding claims 6, 8, 15, 17 Shirane discloses that the substrate includes a three layer structure with two junctions having a center layer with a higher equilibrium carrier concentration, the layer structure comprising a PIN structure (paragraphs 0029, 0050, 0053). Shirane further discloses that the means to inject free charge carriers include biases applied to

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each junction for injecting the carriers into the center layer (paragraphs 0047, 0056-0061; figures 3a, 3b, 4).

Regarding claim 24, Shirane discloses that the device is an optical switch (paragraph 0029, 0049).

Regarding claims 30 and 31, Shirane discloses that the step of locally changing the carrier concentration is performed using a PIN diode (paragraphs 0029, 0050, 0053) or MSM (paragraphs 0066-0068).

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over Shirane et al. in view of the journal article to Joannopoulos et al. (cited by applicant).

Shirane discloses that the air rods are circular (figure 3a), and that the defects are formed by “missing” air rods, such that the radius of the defects could be considered to be zero, such that the diameter of the air rods is larger than that of the defect.

Insofar as Shirane does not teach a local defect having a specific diameter, Shirane is not considered to explicitly teach that the air rods have a larger diameter than the defects.

Joannopoulos teaches photonic bandgap structures having defects with smaller radii than the lattice (figure 3).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Shirane by including defects with a smaller radius than the air rods, as suggested by Joannopoulos. The rationale is as follows: A person having ordinary skill in the art would have been motivated to use rods with a smaller diameter as the defect, because Joannopoulos shows that by varying the diameter of the defect, the specific frequency and symmetry of the electromagnetic wave allowed within the waveguide can be tuned (see figure 3; page 16, columns 1-2). The configuration in Shirane wherein the defects are provided by missing rods restricts the allowed waveguide frequency to a determined level within the bandgap, but by providing defect rods with a selected radius different from the air rods, any frequency from a large range of frequencies in the band gap of the photonic crystal can be selected (see Joannopoulos, page 16).

Allowable Subject Matter

6. Claims 7, 9, 16, and 18 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

7. The following is a statement of reasons for the indication of allowable subject matter:

Although the prior art, such as U.S. Patent Publication No.2002/0146196 to Shirane et al., suggests carrier injection through a PIN or MSM structure, there is no suggestion in the prior art of configuring the photonic bandgap material such that the bandgap is tuned by carrier depletion in a center layer of a PN+P, NP+N, NN+N or PP+P structure. Although it is expected

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that a person having routine skill in the art would understand that the dielectric constant of a semiconductor layer could be altered by both carrier injection and carrier depletion, it is the examiner's opinion that it would not have been apparent that a very highly doped layer would be usable as part of a photonic band gap structure, or that there would be any particular advantage to using a highly doped central layer, and tuning the layer through carrier depletion.

Conclusion

8. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

U.S. Patent Publication No.2002/0159733 to Flory et al. and U.S. Patent No. 6,826,320 to Deliwala et al. disclose tunable photonic crystal structures.

U.S. Patent No. 6,560,006 to Sigalas et al. teaches a photonic crystal having a line defect waveguide formed by varying the radius of the rods.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jennifer M. Dolan whose telephone number is (571) 272-1690. The examiner can normally be reached on Monday-Friday 8:30am-5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl W. Whitehead, Jr. can be reached on (571) 272-1702. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Jennifer M. Dolan
Examiner
Art Unit 2813

jmd

Craig A. Thompson
CRAIG A. THOMPSON
PRIMARY EXAMINER